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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/558,669	11/30/2005	Zuyi Zhang	03500.018177.	8317

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EXAMINER	
NGUYEN, VU ANH	
ART UNIT	PAPER NUMBER
1796	

MAIL DATE	DELIVERY MODE
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/558,669	ZHANG ET AL.	
	Examiner	Art Unit	
	Vu Nguyen	1796	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-7* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-7* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *30 November 2005* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *11/30/2005, 01/04/2007, 02/06/2007*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

3. Claims 1-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over a combination of Ito et al. (WO 02/33709) and Nomora et al. (WO 03/041091) in view of Li et al. (WO 05/001037). *Notes: US 7,160,968, US 7,214,756, and US 2007/0100078 are being used as equivalents of WO 02/33709, WO 03/041091, and WO 05/001037, respectively.*

4. Regarding the limitations set forth in these claims, Ito et al. (Ito, hereafter) teaches a phosphoric acid group-containing polymer electrolyte membrane, its production method, and fuel cells made thereof (Title, col. 2, lines 15-30), wherein the membrane comprising a copolymer of a phosphoric acid group-containing ethylenically

unsaturated monomer and a sulfonic acid group-containing ethylenically unsaturated monomer (col. 2, lines 32-42). The phosphoric acid group-containing ethylenically unsaturated monomer comprises the monomer recited in claim 3 (col. 6-8). The membrane is said to have high electric conductivity and excellent heat resistance and chemical resistance (Abstract). However, no data is given for the performance behavior of the membrane at temperatures above 80°C.

5. Clearly, Ito differs from the claimed invention in that Ito fails to teach a polyelectrolyte membrane comprising a highly cross-linked network resulted from a polymerization reaction and hydrolysis/condensation reactions of methylalkoxysilane, alkoxysilane-containing (meth)acrylate, and the disclosed phosphoric acid group-containing ethylenically unsaturated monomer, and a method of making said membrane.

6. Nomura et al. (Nomura, hereafter) teaches a proton conducting membrane, process of its production, and fuel cells made thereof, wherein the membrane comprising a highly cross-linked network of organic-inorganic hybrid structure prepared by hydrolyzing/condensing a bis(di- or tri-alkoxysilyl)alkane or an OH-terminated polydimethylsiloxane with a sulfonic acid-containing monomer having a cross-linkable group that includes a halide, hydroxysilane, or alkoxysilane (Abstract and Table 1). **[Motivations]** Nomura teaches that a fuel cell, depending on the chemical reaction for its working principle, has a higher energy efficiency when it operates at higher temperature (i.e., 120°C or higher) (col. 2, lines 29-39). “It is a consensus that production of sufficient power is difficult at low temperature, and possible when

temperature is increased to, e.g., 150°C or higher" (col. 2, lines 56-59). Conventional sulfonated fluorinated resin-based membranes have a maximum allowable temperature of 80°C for stable operation for extended periods (col. 2, lines 26-28). Attempts at increasing the heat resistance of proton-conducting membranes by using aromatic polymers have numerous drawbacks (col. 3). On the other hand, membranes made of inorganic materials such as hydrolyzing/condensing acid-containing hydrolysable silyl compounds, though exhibiting good proton conductivity at high temperature, are difficult to process and do not have stable structure at high temperatures as the membranes tend to be cracked (col. 4, lines 1-9). The disclosed membranes, being a hybrid structure, has improved heat resistance, durability, dimensional stability, fuel barrier characteristics, and high proton conductivity at high temperature (col. 4, lines 46-52).

7. Li et al. (Li, hereafter) teaches hybrid inorganic-organic polymer electrolyte membranes based on alkoxysilane-grafted thermoplastic polymers. The membranes are prepared by grafting a thermoplastic polymer [0006, 0009, 0016-0017] with alkoxysilane-containing monomers such as methacryloxypropyltrimethoxysilane [0011, 0017, 0023], followed by hydrolysis/condensation with alkoxysilanes such as tetraethoxysilane [0013] and treatment with a proton-conducting species such as H_3PO_4 [0014]. The membranes therefore contain Si-O-Si network [0010]. **[Motivations]** Unlike conventional proton electrolyte membranes which can usually be operated below 80°C [0003] and are not thermally stable over 120°C, especially membranes containing sulfonic acid groups [0004], the disclosed membranes are stable and have good proton conductivity at high temperatures [0051, 0039-0040].

8. From these teachings, it is obvious to one skilled in the art that a good polymer electrolyte membrane (1) should have a highly cross-linked Si-O-Si network, (2) should be an inorganic-organic hybrid structure, and (3) should contain phosphonic acid instead of sulfonic acid. In view of the phosphoric acid group-containing ethylenically unsaturated monomer taught by Ito and the grafting method taught by Li, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to have combined the phosphoric acid group-containing ethylenically unsaturated monomer with the alkoxysilane-containing (meth)acrylate monomers and the alkoxysilanes to prepare proton-conducting membranes that are stable at a temperature of 120^{o}C or greater and have good performance at such temperature for extended periods. Further, it would have been obvious to a person having ordinary skill in the art that such membrane can be prepared either by polymerizing the ethylenically unsaturated bonds first followed by hydrolysis then cross-linking (condensing) with the alkoxysilanes, or equivalently, hydrolyzing and partially condensing the alkoxysilane-containing (meth)acrylate monomers followed by polymerizing the ethylenically unsaturated bonds (with the phosphate-containing monomers) and subsequently cross-linking the resulting polymer with the alkoxysilanes. Both methods are expected to give similar end results.

Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Vu Nguyen whose telephone number is (571)270-5454. The examiner can normally be reached on M-F 7:30-5:00 (Alternating Friday Off).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Wu can be reached on 571-272-1114. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Vu Nguyen
Examiner
Art Unit 1796

/James J. Seidleck/

Supervisory Patent Examiner, Art Unit 1796